(12) **INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)**

(19) World Intellectual Property Organization [WIPO] [Bar Code]
International Bureau

(43) International Publication Date
May 6, 2004 (05/06/2004)

(10) International Publication Number
PCT **WO 2004/038230 A1**

(51) International Patent Classification[7]: **F15B 1/24**

(21) International Application No.: PCT/EP2003/008517

(22) International Filing Date: August 1, 2003 (08/01/2003)

(25) Language in which the international application was originally filed: German

(26) Language in which the international application is published: German

(30) Priority Data:
102 48 823.1 October 19, 2002 (10/19/2002) DE

(71) Applicant *(for all designated states except the US)*: **HYDAC TECHNOLOGY GMBH** [DE/DE]; Industriegebiet, 66280 Sulzbach/Saar (DE).

(72) Inventor; and

(75) Inventor/Applicant *(US only)*: **BALTES, Herbert** [DE/DE]; Bornstr. 22, 66679 Losheim (DE).

(74) Representative: **BARTELS AND PARTNER**; Lange Strasse 51, 70174 Stuttgart (DE).

(81) Designated States *(national)*: JP, US.

[continued on next page]

(54) Title: **48665**

Patent Application

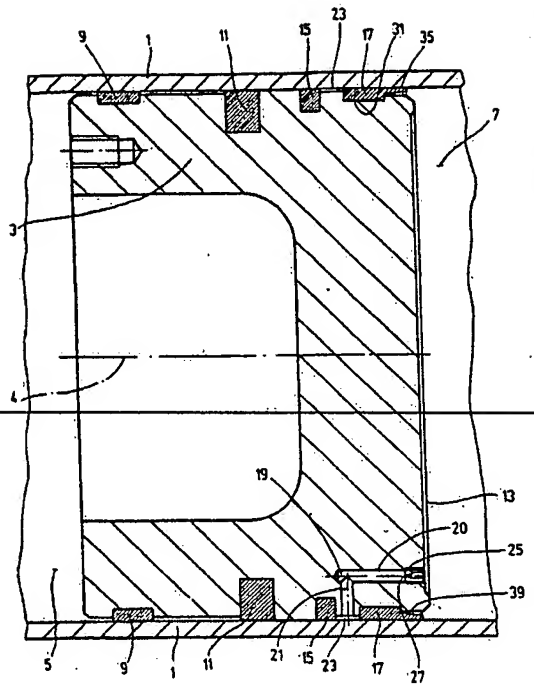
of

HERBERT BALTES

for

HYDRAULIC ACCUMULATOR

WO 2004/038230 A1



(57) **Abstract:** The invention concerns a hydraulic accumulator comprising a piston (3) capable of moving in an accumulator housing (1) in the axial direction thereof, and separating a gas side (5) from a liquid side (7) of the accumulator housing (1). Guide elements (9, 17) designed to co-operate with the accumulator housing wall (1), as well as at least one sealing element (15) are arranged at the periphery of said piston. The sealing element is arranged offset in the axial direction relative to the guide elements (9, 17), in said peripheral part of the piston (3) located between said guide elements. In the piston (3) is a pressure compensating channel (19) which forms, at the piston periphery, a liquid flow path between the liquid side (7) and a space (2) located between the guide element (17) nearest to the liquid side (7) and the sealing element immediately next in the axial direction. A device (25) reducing the cross-section of the passage of the pressure compensating channel (19) is located therein.

(57) **Zusammenfassung:** Bei einem Hydrospeicher mit einem im Speichergehäuse 1 in dessen Axialrichtung bewegbaren, eine Gasseite 5 von einer Fluidseite 7 des Speichergehäuses 1 trennenden Kolben 3, an dessen Umfang für die Zusammenwirkung mit der Wand des Speichergehäuses 1 vorgesehene Führungselemente 9, 17 und zumindest ein Dichtelement 15 vorhanden sind, das, in Axialrichtung zu den Führungselementen 9 und 17 versetzt, in dem zwischen diesen gelegenen Umfangsabschnitt des Kolbens 3 angeordnet ist, ist im Kolben 3 ein Druckausgleichskanal 19 vorgesehen, der einen Fluidweg zwischen der Fluidseite 7 und einem Raum 23 am Kolbenumfang bildet, welcher Raum 23 zwischen dem der Fluidseite 7 nächstgelegenen Führungselement 17 und dem

[Fortsetzung auf der nächsten Seite]

~~WO 2004/038230 A1~~ ~~[Bar Code]~~Field of the Invention

~~(84) Designated States *(regional)*: European Patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).~~

~~*Reference is made for an explanation of the two-letter codes and the other abbreviations to the Guidance Notes on Codes and Abbreviations in the front section of each regular PCT Gazette edition.*~~

~~**Published:**~~
~~*With International Search Report.*~~

~~Hydac Technology GmbH, Industriegebiet, 66280 Sulzbach/Saar~~

~~Hydraulic Accumulator~~

The present invention relates to a hydraulic accumulator with ~~the features specified in the preamble of claim 1~~a piston which can be moved in the accumulator housing in its axial direction and which separates the gas side from the fluid side of the accumulator housing. On the periphery of the piston, guide elements are provided for interaction with the wall of the accumulator housing. At least one sealing element, offset in the axial direction to the guide elements, is located in the peripheral section of the piston situated between the guide elements.

Background of the Invention

Piston accumulators ~~of this type~~ are commercially available and are widely used in hydraulic systems in a variety of applications~~, for~~. For example, they are used for storing energy, emergency actuation, leaking oil compensation, volume compensation, shock absorption, pulsation damping, and the like.

Long-term behavior is of very great importance for economical and reliable use of these accumulators. ~~In order to~~ To guarantee operating behavior which is satisfactory in this regard, it

must be ensured that the oil overflow from the fluid side which normally contains hydraulic oil to the gas side is minimized over the entire service life. Current hydraulic accumulators do not meet this requirement to an adequate degree.

DE 14 50 347 A discloses a generic hydraulic accumulator with a piston which can be moved in the accumulator housing in its axial direction and which separates the gas side from the fluid side of the accumulator housing~~, on the~~. The periphery of the piston ~~there being~~has guide elements ~~which are intended for interaction~~that interact with the wall of the accumulator housing, together with at least one sealing element ~~which is~~ offset in the axial direction to the guide elements~~,~~ ~~between~~. Between the guide element ~~which is~~ nearest the piston side ~~which borders the~~ bordering on the fluid side~~,~~ and the sealing element which is offset in the axial direction to the gas side and which is the next one following in the axial direction, a pressure equalization channel ~~discharging~~discharges on the periphery of the piston ~~which~~ and forms in the piston a fluid path to the fluid side~~, and in the~~. The pressure equalization channel ~~there being~~ contains a device which reduces its passage cross-section. In the known solution, the piston is formed from two piston parts which are held at a distance to one another by an energy accumulator in the form of a compression spring and which are routed within the accumulator housing along a common guide rod ~~which forms~~forming a stop.

Due to the motion of the overall piston within the accumulator housing, there is a pressure difference between the fluid side and the intermediate space which is located on the periphery of the piston between the guide element on the fluid-side end of the piston and the sealing element which follows next in the axial direction. Due to this pressure difference, a volumetric flow into the intermediate space between the guide element and sealing element occurs over the guide element~~,~~ ~~entrained~~. Entrained dirt particles ~~being~~ are deposited in this way between the guide element and the piston~~, and due~~. Due to movement of the overall piston, these particles can lead to scratches which adversely affect the system. The described pressure equalization channel eliminates the problem in that when the piston moves, no pressure difference occurs on the guide element and thus a volumetric flow which may be loaded with dirt particles is not produced. In the known solution it

is possible that when the piston moves, dirt particles which may have already collected on the inside wall of the accumulator housing are run over in piston movements ~~and in this way~~ to damage the piston.

To prevent this problem, the prior art (DE 36 19 457 A) suggested a cylindrical hydraulic ~~accumulators~~ accumulator for hydraulic systems, ~~consisting of~~having an accumulator housing cylinder ~~which is~~ closed on its two faces ~~and in which there is a~~. A floating piston ~~which~~ in the housing cylinder divides the cylinder into two spaces ~~and which towards~~. Towards its seal against the inside cylinder wall on the two ends of its outside wall, the piston has one recess each~~, in which one~~. In one recess, a respective groove-packing ring of elastomer is arranged, such that its annular groove is pointed toward the pertinent piston face~~; however~~. However, this measure is not sufficient for effectively deterring dirt particles. The known groove-packing rings each have in cross-section a tetragonal profile sectional area which undergoes transition toward the pertinent face of the piston into a U-shaped profile cross-sectional area~~, the~~. The U-shaped profile cross-sectional area ~~projecting~~projects radially over the tetragonal profile cross-sectional area as a plain compression ring ~~and the~~. The tetragonal profile cross-sectional area in its entire width ~~being~~ is enclosed by a support ring of a high-strength material, preferably of a carbon fiber winding bonded in resin, with an outer surface which adjoins the inside cylinder wall, sliding almost without play. In the U-profile area which is left clear, dirt can collect which can adversely affect the sealing function~~, and the~~. The projecting angular stripper edge of the seal, which edge is configured to be solid, is designed too stiffly for an effective sealing and stripping function.

~~On the basis of the most similar generic prior art in the form of a~~ Summary of the Invention

An object of the present invention is to provide an improved hydraulic accumulator with a pressure equalization channel in the piston~~, the object of the invention is to further improve the pertinent solution~~ such that improved long-term operating behavior can be achieved. ~~This object is achieved by a hydraulic accumulator with the features of claim 1 in its entirety.~~

In a hydraulic accumulator ~~of the type referred to~~ with a pressure equalization channel in the ~~foregoing~~piston, this object is achieved ~~as claimed in the~~according to the present invention in that the guide element nearest the fluid side of the piston is located closely adjacent to the fluid-side end of the piston and is formed by a guide belt with a dirt stripper lip which extends at least approximately to the end of the piston~~, that the~~. The guide belt has a plain compression ring which sits in an annular groove of the piston periphery with a dirt stripper lip which lengthens its radially outside annular surface on one side in the axial direction and which tapers towards its end edge~~, and that the~~. The piston in the peripheral area which extends from the fluid-side end to the annular groove has a section of reduced outside diameter over which the dirt stripper lip extends. In this way, dirt particles which may have already collected on the inside wall of the accumulator housing are prevented with certainty from being run over when the piston moves. The stripper lip of the plain compression ring in particular also contributes to this~~; the~~ prevention. The stripper lip extends tapering to the outside and, located in the area of the piston end, extends preferably over an axial length which is somewhat larger than half the axial length of the plain compression ring.

The device which reduces the passage cross-section of the pressure equalization channel ensures that only a small fluid volume is involved in the process of pressure equalization.

The device which causes a reduction of the passage cross-section of the pressure equalization channel preferably reduces the passage cross-section so dramatically that as a result of the narrowing of the cross-section the action of a particle filter arises. Even a minimum volumetric flow through the pressure equalization channel, as arises for pressure equalization during movements, ~~thus~~ does not lead to transport of dirt particles into the intermediate space which is located downstream of the guide element on the periphery of the piston.

The device which reduces the passage cross-section can be a choke device, for example a nozzle which is inserted into the pressure equalization channel, with a correspondingly small nozzle opening which acts as a particle filter.

Instead of a choking nozzle~~,~~ as the device which narrows the cross-section ~~there can be,~~ a porous filter element ~~which is~~ can be inserted into the pressure equalization channel.

~~The invention will be described in detail below using one exemplary embodiment which is shown in the drawings in which~~

Other objects, advantages and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses a preferred embodiment of the present invention.

Brief Description of the Drawings

Referring to the drawings which form a part of this disclosure:

FIG. ~~1 shows a cutaway~~ 1 is a side elevational view in longitudinal section of a piston accumulator according to one exemplary embodiment of the present invention, ~~simply~~where the section of the accumulator housing being shown is in which the piston is located~~,~~; and

FIG. 2 ~~shows~~ is a partial side elevational view in longitudinal section of a piston guide element of the exemplary embodiment ~~from~~ of FIG. 1, which section is drawn with a highly enlarged scale compared to FIG. 1, in the form of a plain compression ring with a projecting dirt stripper lip.

~~Of the~~Detailed Description of the Invention

The exemplary embodiment of the hydraulic accumulator ~~as claimed in~~according to the present invention ~~which will be described~~ is in the form of a piston accumulator. FIG. 1 shows only the section of the accumulator housing 1 in which the piston 3 is located. It forms a separating element which can move in the axial direction, i.e., along the longitudinal axis 4, between the gas side 5 and the fluid side 7 of the accumulator housing 1.

In hydraulic accumulators ~~which are~~ incorporated into hydraulic systems, the gas side 5 is conventionally filled with nitrogen gas, while the fluid side 7 in operation conventionally contains hydraulic oil. The sealing and guidance system ~~which~~ acts between the periphery of the piston 3

and the inside wall of the accumulator housing 1 ~~and which~~, prevents overflow of media from one piston side to the other piston side, and ~~which~~ forms a piston guide when the piston 3 is moving~~;~~. Such system has a plurality of components ~~which are~~ provided on the periphery of the piston 3. In succession, in FIG. 1 in the axial direction from left to right, ~~they~~the components are a guide element which is adjacent to the fluid-side end of the piston 3 in the form of a guide belt 9, a first piston seal 11 which is located at an axial

~~Claims~~

~~Hydraulic accumulator with a piston (3) which can be moved in the accumulator housing (1) in its axial direction and which separates the gas side (5) from the fluid side (7) of the accumulator housing (1), on the periphery of the piston there being guide elements (9, 17) which are intended for interaction with the wall of the accumulator housing (1), and at least one sealing element (15), which, offset in the axial direction to the guide elements (9, 17), is located in the peripheral section of the piston (3) which is located between the guide elements, between the guide element (17) which is nearest the piston side which borders the fluid side (7), and the sealing element (15) which is offset~~ distance from guide belt 9 approximately in the central area of the piston 3, a second piston seal 15 which is further offset relative to the first piston seal in the axial direction ~~to the gas side (5) and which is the next one following in the axial direction, a pressure equalization channel (19) discharging on the periphery of the piston which forms in the piston (3) a fluid path to the fluid side (7), and in the pressure equalization channel (19) there being a device (25) which reduces its passage cross section, characterized in that the guide element nearest the fluid side (7) of the piston (3) is located closely adjacent to~~toward the fluid-side end ~~(13) of the piston (3) and is formed by a guide belt (17) with a dirt stripper lip (35) which extends at least approximately to the end (13)~~ of the piston ~~(3), that the guide belt (17) has a plain compression ring (29) which sits in an annular~~

~~groove (31)~~3, and a guide element which is still further offset toward the end 13 of the piston ~~periphery with a dirt stripper lip (35) which lengthens its radially outside annular surface (33) on one side~~3 in the ~~axial direction and which tapers towards its end edge (37), and that the piston (3) in the peripheral area which extends from the fluid-side end (13) to the annular groove (31) has a section (39)~~form of ~~reduced outside diameter over which the dirt stripper lip (35) extends~~a guide belt 17.

~~2. The hydraulic accumulator as claimed in claim 1, wherein the device (25) which reduces the passage cross-section of the pressure equalization channel (19) reduces the passage cross section so dramatically that it acts as a particle filter.~~

~~3. The hydraulic accumulator as claimed in claim 2, wherein the device which reduces the passage cross section is formed by a choke device (25).~~

~~4. The hydraulic accumulator as claimed in claim 3, wherein the choke device has a nozzle (25).~~

~~5. The hydraulic accumulator as claimed in claim 4, wherein the nozzle (25) on the piston side which borders the fluid side (7) is inserted into the mouth of the pressure equalization channel (19).~~

~~6. The hydraulic accumulator as claimed in claim 3, wherein the choke device is formed by a porous filter element which is located in the pressure equalization channel (19).~~

~~7. The hydraulic accumulator as claimed in one of claims 1 to 6, wherein the plain compression ring (29) with the dirt stripper lip (35) which is integral with it is formed from an elastomer material.~~

As seen in the lower part of FIG. 1, a pressure equalization channel 19 is in piston 3, and is formed from two blind holes which undergo transition into one another. One blind hole 20 proceeds from the end 13 of the piston 3, and extends parallel to the longitudinal axis 4. The other blind hole 21 extends at a right angle to blind hole 20, and proceeds from the periphery of the piston 3. Blind hole 21 on the periphery of the piston discharges into an intermediate space 23 located between the guide belt 17 and the piston seal 15 extending therebetween in the axial direction.

As a result of hydrodynamic circumstances, in operation when the piston 3 moves a pressure difference arises between the space 23 and the pressure of the hydraulic oil located on the fluid side 7. This pressure difference in the absence of a pressure equalization channel 19 leads to a slight volumetric flow over the guide belt 17. As already mentioned, entrained particles deposited between the inside wall of the housing 1 and the piston 3 can lead to disruptions of the sealing and guidance system. The pressure equalization channel 19 of the present invention avoids the formation of a corresponding pressure difference, and thus, the corresponding oil overflow.

To preclude the danger of a fluid flow, which occurs in the pressure equalization channel 19 during the process of pressure equalization and which is able to cause particles to be brought into the space 23, the present invention provides a narrowing of the passage cross-section of the channel 19.

In the embodiment shown in FIG. 1, this device is formed by a nozzle 25 inserted into the mouth of the hole 20 of the channel 19 on the end 13 of the piston 3. The nozzle hole 27 is chosen to be of such small dimension here that it acts as a particle filter so that no particles which have a dimension greater than that of the hole 27 can travel into the space 23 by way of the channel 19.

Instead of using a nozzle hole 27 of correspondingly small dimensions as a particle filter, a filter element could be inserted into the pressure equalization channel 19, preferably in its hole 20.

To avoid the further danger of adversely affecting the sealing and guidance system, which could occur due to dirt particles which have already collected on the inside wall of the housing 1, the guide belt 17 is made additionally as a stripper element with a structure shown particularly in FIG. 2. As shown, the base part of the guide belt 17 performs the function of the piston guide in interaction with the inside wall of the housing 1, and has a plain compression ring 29 supported in an annular groove 31 machined into the periphery of the piston 3. The outer annular surface 33 of the plain compression ring 29 forms the guide surface, and is lengthened in the axial direction to form the stripper lip 35. The stripper lip extends over an axial length somewhat greater than half the axial length of the plain compression ring 29 (FIG. 2). As is likewise clearly seen from FIG. 2, the lip 35 tapers, proceeding from its root on the plain compression ring 29, as far as the end edge 37 with a tapering angle α. In the example shown, the angle is approximately 10 degrees relative to the axial direction. As is likewise seen from FIG. 2, the radial thickness of the lip 35 on its root bordering the plain compression ring 29 is somewhat less than half the radial thickness of the plain compression ring 29.

In the guidance and stripper element which forms the guide belt 17, the plain compression ring 29 and the stripper lip 35 are formed integrally of an elastomer material so that the plain compression ring 29 can be snapped into the annular groove 31 on the piston 3 and the lip 35 extends projecting in a flexible manner. As seen in FIG. 1, the lip 35 extends over the end-side peripheral section 39 of the piston 3. This section extends into the area of the fluid-side end 13, and is somewhat reduced in outside diameter. Due to the intermediate space formed in the section 39 between the piston 3 and the lip 35, lip 35 can be conformed in an elastically flexible manner to the inside wall of the housing 1, by means of which the lip 35 achieves an optimum stripper action.

Efficient operating behavior can be ensured over a very long service life by the configuration of the guidance and sealing system provided in the present invention. The pressure equalization between the space 23 on the piston periphery and the fluid side 7 and the measures provided combine to prevent settling of dirt particles on the inside wall of the housing 1.

The guide belt 9 is shown on the left as viewed in FIG. 1 can be designed comparably to the guide belt 17 shown on the right and/or can be replaced by it.

While one embodiment has been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

HYDRAULIC ACCUMULATOR

Abstract of the Disclosure

A hydraulic accumulator includes a piston (3) capable of moving in an accumulator housing (1) in its axial direction and separating a gas side (5) from a liquid side (7) of the accumulator housing (1). Guide elements (9, 17) designed to co-operate with the accumulator housing wall (1), as well as at least one sealing element (15), are arranged at the periphery of the piston. The sealing element is arranged offset in the axial direction relative to the guide elements (9, 17), and is located between the guide elements. In the piston (3), a pressure compensating channel (19) forms, at the piston periphery, a liquid flow path between the liquid side (7) and a space (2) located between the guide element (17) nearest to the liquid side (7) and the sealing element immediately next in the axial direction. A device (25) reducing the cross-section of the passage of the pressure compensating channel (19) is located in it.